4. On the Pouch and Brain of the Male Thylacine.

By Frank E. Beddard, M.A., Prosector to the Society.

[Received January 31, 1891].

On the 5th day of February of last year the male Thylacine which was purchased by the Society in 1884 died. Its death gave me the opportunity of noting a few points in the structure which have not been as yet described and figured, or have been only briefly and incompletely dealt with.

The Pouch.

The specimen being a male, I was greatly surprised to find a distinct though small pouch, which is shown in the accompanying drawing (fig. 1, p. 139). On referring, however, to the literature of the subject, I discovered that the existence of a pouch in the male Thylacine, although unknown to me, had been previously noted. Sir Richard Owen has thus described [1] it :— "In the male Thylacine the rudimentary marsupium is retained in the form of a broad triangular depression or shallow inverted fold of the abdominal integument, from the middle of which the peduncle of the scrotum is continued."

This account is repeated in the 'Anatomy of Vertebrates' by the same author.

Sir Richard Owen refers in his article "Marsupialia" to a paper by Laurent [2], in which the fœtus of the male Opossum is stated to possess a trace of this pouch. There is a description of this structure illustrated by figures in another paper [3] by the same writer, to which I have been able to refer. It is there stated that the male mammary fœtus of *Didelphis virginiana* has a pouch as well as teats, but that there are no traces in the adult of either structure. The figure which Laurent [4] gives is not at all unlike the drawing of the Thylacine's pouch which I herewith submit to the Society; the scrotum depends from the pouch in a precisely similar way. M. Laurent did not find the pouch to be present in the other species of *Didelphis* which he examined.

A recent paper upon the same subject [5], but dealing with a large

[1] Todd's Cyclopædia, Article Marsupialia, vol. iii. p. 328.

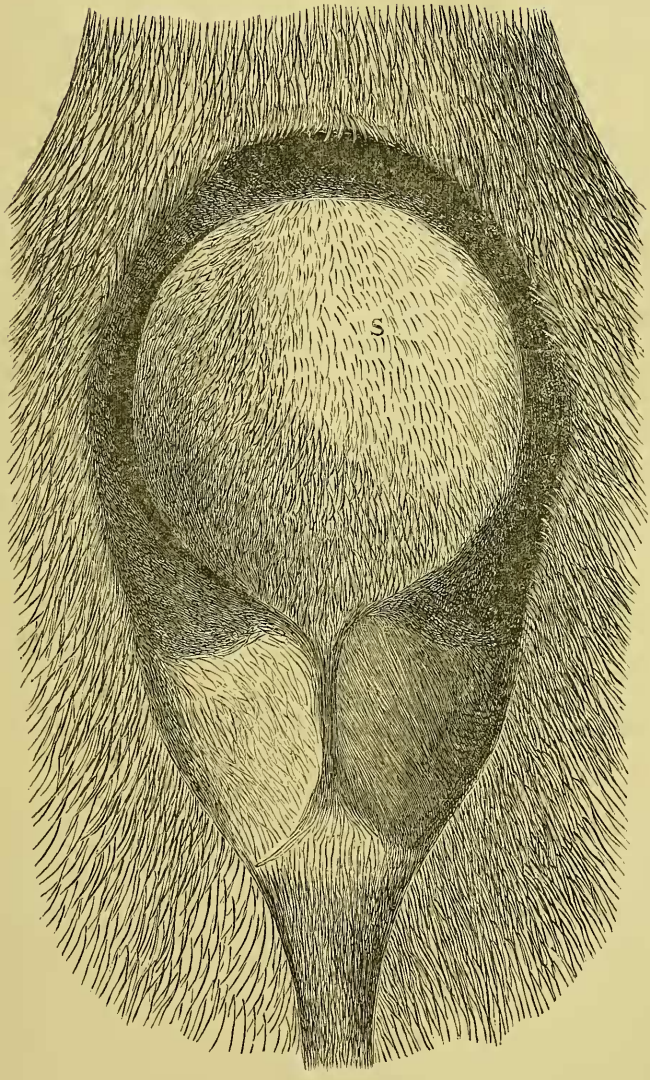
[2] "Recherches Anatomiques et Physiologiques sur les Mammifères Marsupiaux," Annales Franç. d'Anat. et Phys. 1839, vol. iii. p. 231. This paper is called "Extraits de plusieurs mémoires insérés dans la zoologie du voyage de la *Favorite*," &c.

[3] "Recherches Anatomiques et Physiologiques sur les Mammifères Marsupiaux," Mag. de Zool. 1837. This paper is repeated, with the Plates, in the 'Voyage de la *Favorite*,' 1839.

[4] Pl. 22. figs. 1, 1*a*, 1*b*.

[5] O. Katz, "Zur Kenntniss der Bauchdecke und der mit ihr verknüpften Organe bei den Beutelthieren," Zeitschr. wiss. Zool. Bd. xxxvi. pp. 611–670, pls. xxxviii., xxxix.

Fig. 1.



Pouch of young male Thylacine. *S*, Scrotum.

variety of different types, shows that the transitory existence of a pouch in the young male is quite a common feature among Marsupials, especially perhaps among the carnivorous forms.

A pouch was found in the young male *Dasyurus ursinus* up to the age of four months (its length being at that time 19·8 cm.), and one occurs in the young *Acrobates pygmæa*.

A pouch was barely traceable in the young male *Phalangista vulpina*, just visible in a 4·6 cm. long *Belideus breviceps*, three weeks old. The adult males of these forms have of course no pouch nor trace of one.

In *Perameles nasuta* there was a trace of a pouch discoverable in the young, but none in *Halmaturus thetidis*.

The pouch is stated to open backwards in *Dasyurus*, as Owen says of *Thylacinus* and MM. Eydoux and Laurent of *Perameles*.

It is evident from the paper to which I have referred, that the existence of a pouch, transitory or otherwise, among the male Marsupials is not confined to the carnivorous section of the Order, though apparently more commonly met with and longer persistent among the members of that section.

As the organ in the male Thylacine has not to my knowledge been illustrated, I have thought it desirable to have the accompanying drawing (p. 139) prepared.

The figure shows the pouch, which was sketched by Mr. Smit immediately after the death of the animal, and the scrotum containing the testicles, which depends from the interior of the pouch. The drawing also shows that there is not merely a tract of naked skin surrounding the testes, but a deepish pouch which is overhung by the surrounding integument; the pouch is deepest in front and gradually gets shallower behind; it follows therefore that the pouch is directed backwards as in *Perameles*. The general outline of the pouch is oval, or rather pear-shaped, for there is a narrow continuation of it backwards; the scrotum supported on a short stalk depends from the interior of the pouch nearer to the posterior than to the anterior extremity.

The Brain.

In order to injure the skull as little as possible, the brain was extracted in two halves, the skull having been sawn through the median vertical longitudinal plane. The brain was hardened in alcohol, and had a curious yellow colour not always seen in brains so prepared; the brains of a Kangaroo and a Wallaby, which I had prepared for comparison with that of the Thylacine, were white; on the other hand, the brain of a Sloth (also preserved in alcohol) showed the same brownish-yellow tint.

The total length of the brain, measured from the end of the cerebellum to the anterior extremity of the olfactory lobe, was 76 millim.

Greatest length of cerebral hemispheres 48 millim.

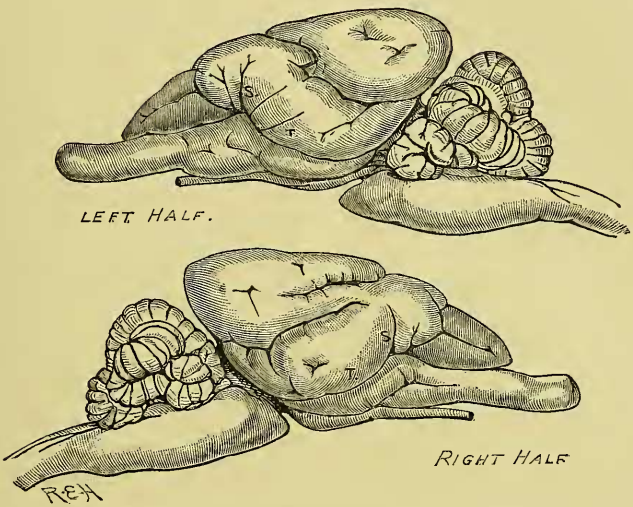
Greatest height of cerebral hemispheres 26 millim.

These measurements refer in all cases to the hardened brain.

The only descriptions of the Thylacine brain with which I am acquainted are contained in Professor Flower's memoir upon the Marsupial brain [1], that by Gervais, and that by Sir Richard Owen in the 'Anatomy of Vertebrates.' Prof. Flower figures the internal aspect of a longitudinal median section as well as a transverse section through the corpus callosum. His description of the brain is limited to the following passage in his paper (p. 646):—

"The large carnivorous Marsupial, the Thylacine (*Thylacinus*

Fig. 2.



Brain of Thylacine, right and left halves, a little reduced from natural size. *S*, Sylvian fissure. *T*, Rhinal fissure.

cynocephalus), so widely separated in external characters from both the Kangaroo and Wombat, shows the same general peculiarities of cerebral organization, but attended with a smaller development of the superior transverse commissure, especially of its anterior part, and a greater reduction of the thickness of the interventricular septum."

Sir Richard Owen (*loc. cit.* vol. iii. p. 105) remarks that *Thylacinus* "has the anterior apex of the hemisphere marked off by a deeper transverse fissure, extending to the inner surface," and that "there is a short fissure above the back part of the hippocampal one." He does not, however, refer to any fuller description of this brain, but

[1] "On the Commissures of the Cerebral Hemispheres of the Marsupialia and Monotremata as compared with those of the Placental Mammals," Phil. Trans. 1865, pp. 633–651, pls. xxxvi.–xxxviii.

only to Prof. Flower's paper already cited and to a paper by himself [1] which contains no description or figures of the Thylacine's brain.

Gervais's description [2] is not taken from the actual brain, but from a cast of the interior of the skull which is figured [3] from above: he writes:—"The principal peculiarities presented by this cast consist in the preponderance of the posterior lobule of the hemispheres over the anterior, and, in consequence of this peculiarity, in the forward position of the Sylvian fissure. The anterior lobule is besides more compressed than in other Marsupials, and we have already seen in that fact a means of removing *Thylacoleo* from *Thylacinus* in classification. In the last-mentioned form the olfactory lobules are borne by a strong peduncle and they project notably beyond the anterior border of the hemispheres. As regards the hemispheres themselves, it appears that they are not without convolutions; it is easy to distinguish one around the Sylvian fissure, and there is a marked transverse depression nearly median, although laterally it tends towards the posterior boundary. It marks the line of division between the two lobes, and may be considered as representing the fissure of Rolando. An anterior depression corresponds to the crucial sulcus, and there are traces of convolutions in the part which forms the posterior lobule."

Since the Thylacine is an animal which is getting scarcer, I have thought that an attempt at a fuller description of the brain than is to be found in the memoirs cited might be acceptable, particularly if illustrated sufficiently.

The press of other work unfortunately prevented me from studying the brain in the fresh condition, which would have been very desirable. Prof. Huxley [4] points out what erroneous conclusions may be reached by drawing inferences from the preserved brain only. But I am inclined to think that he has a little exaggerated the danger which is incurred from this proceeding. At any rate I can find no such alteration in the direction of the fissures in the brain of a Kangaroo which I sketched before and after preservation in alcohol. It is noticeable that the brains figured by Prof. Huxley, in which an alteration is to be observed, are of different sexes, though of about the same size. With brains prepared as carefully as they are in my laboratory, the danger of alteration is reduced to a minimum.

In the brain when viewed from above, the cerebral hemispheres, as in other Marsupials, do not only not overlap the cerebellum, but they only just reach it; they come nearer, however, than in the Wallaby (*Halmaturus bennetti*) or in the Koala (*Phascolarctos*) according to Mr. W. A. Forbes [5], or in the Opossum according to Owen [6]. This,

[1] "On the Structure of the Brain in Marsupial Animals," Phil. Trans. 1837, pp. 87–96, pls. v.–vii.

[2] "Mémoire sur les Formes Cérébrales propres aux Marsupiaux," Nouv. Arch. Mus. t. v. pp. 229–251, pls. xiii., xiv.

[3] Pl. xiv. fig. 7.

[4] "On the Brain of *Ateles paniscus*," P. Z. S. 1861, pp. 247–260, pl. xxix.

[5] "On some points in the Anatomy of the Koala (*Phascolarctos cinereus*)," P. Z. S. 1881, p. 191, fig. 3.

[6] Phil. Trans. *t. c.* pl. v. fig. 6.

coupled with the divergence of the two hemispheres posteriorly, leaves the corpora quadrigemina partially exposed. The degree to which the corpora quadrigemina are exposed is about the same as in the Kangaroo, but considerably less than in the Wallaby or Opossum, or for the matter of that in the Rodent *Dolichotis*, the brain of which I propose to describe later.

The cerebral hemispheres are not greatly convoluted. Judging from Owen's figures of the Opossum and the *Dasyurus ursinus*, there is a progressive complication of the folds in passing from the smaller to the larger forms, such as is often seen among mammals; the Thylacine, which is the largest animal, has the greatest development of furrows of the three. Nevertheless the brain of this Marsupial is much smoother than that of a Kangaroo of about the same size. Sir Richard Owen's figure of the Dasyure's brain [1] is a little indistinct; I am not therefore able to compare it with the Thylacine very accurately. As compared with the Kangaroo [2], the sulci are less numerous and often shallower.

In the Kangaroo's brain the Sylvian fissure is deep and the convolutions are arranged in a series of arches round and above this fissure, as in the Carnivora; the "arched" arrangement is perhaps not so plain as in the Carnivora, and there are only two arches. In the Thylacine such an arrangement of the gyri could not be made out, the principal furrows passing obliquely so as to divide the brain into three unequal segments. The furrow separating the hemispheres proper from the olfactory portion (the hippocampal gyrus) is well marked, and as usual is bent upwards at about the middle of its course, but the angle formed is not so acute as in *Macropus*. From the highest point of this bend arises the Sylvian fissure (*S*, fig. 2, p. 141), which passes nearly vertically upwards and is about half an inch in length. On one side of the brain the Sylvian fissure could be followed as a very shallow groove into the posterior of the two principal sulci.

On a dorsal view the hemispheres are seen to be divided into three unequally sized areas by two furrows running obliquely and approximately parallel to each other. The posterior fissure reaches the middle line of the brain 29 mm. in front of its posterior boundary, *i. e.* 19 mm. behind anterior boundary of hemispheres. On the left side of the brain this fissure runs parallel with the rhinal fissure; the commencement only is shown in Gervais's figure: near to its posterior termination it gives off a short descending fissure which does not reach the rhinal fissure, but stops short about a

[1] *Loc. cit.* pl. v. fig. 5.

[2] I follow Owen's figure (Phil. Trans. 1837, pl. v. fig. 4, and pl. vi. fig. 1), which, except for some slight differences, probably individual, agrees with a brain in my possession. Gervais's figure of the brain of a "Kangurou géant" (*loc. cit.* pl. 13. fig. 1), which I take to be the same species, is that of a larger individual (?) and is more convoluted, and the convolutions are a little different; but the cast which he figures is like the brain before me. Sir W. Turner's figure ("The Convolution of the Brain; A Study in Comparative Anatomy," Journ. Anat. Phys., Oct. 1890, p. 118. fig. 11) of *Macropus major* is nearly identical with the brain I have examined.

quarter of an inch in front of it. On the right hemisphere this fissure is slightly different, as will be seen from a comparison of figs. 2 and 3, and the indentations on the posterior lobe are a little better marked.

The second furrow is continuous with the rhinal furrow just in front of the Sylvian fissure; its course is much the same on both sides of the body. The anterior lobe of the brain cut off by this fissure is U-shaped, a longitudinally running furrow nearly dividing it into two.

Sir William Turner[1] remarks that "the configuration of the brain and the pattern of the convolutions have followed in each order a process of evolution characteristic of the order, the arrangement of the convolutions does not follow the same plan in the various orders. Hence, in the comparison of the brains of mammals with each other, diversities often are recognized which make it impossible to determine the presence of precisely homologous fissures and convolutions in the whole series of the Gyrencephala."

It appears to me that this statement might also be extended in the case of the Marsupials to a single order; it is extremely difficult to compare the convolutions of the brain of *Thylacinus* with those of the brain of *Macropus*.

The points which they have in common are:—(1) The strongly marked and continuous rhinal fissure; but this is found in most mammals. (2) The separation of an anterior lobe (*cf.* fig. 2, p. 141) by a transverse fissure; such a lobe is not for example to be seen in the brain of *Dolichotis*, nor is it of course to be seen in the "lissencephalous" Koala &c. Judging from Gervais's figures this lobe was particularly conspicuous in the extinct *Thylacoleo*. M. Gervais's observations upon the cast of the brain of this latter Marsupial are of particular interest in relation to a well-known controversy. I may remark, however, that the brain of *Thylacoleo* appears to have differed from those of the Wombat and Kangaroo no less than from that of the Thylacine by the *outward* direction of the longitudinal furrow dividing the anterior lobe. However, in *Halmaturus bennetti* the furrows in question are intermediate between the two extremes, being straight. It appears to me that *Halmaturus* and *Hypsiprymnus* come much nearer to *Thylacoleo* than the Wombat does in the form of their cerebral convolutions. M. Gervais himself considers that the Wombat is the closest ally of *Thylacoleo* in these points of structure. (3) In common with many other lower mammals, the lobus hippocampi is not marked by furrows, and is not covered by an extension downwards of the pallium. Finally, of course, there are the important differences in the commissures.

With the exception of the Sylvian fissure and the sulcus which divides off the anterior lobe of the brain and the rhinal furrow, it seems to me to be very difficult to compare the furrows and convolutions of *Thylacinus* with those of the Diprotodont Marsupials. The Sylvian fissure is directed at first slightly forwards, and then

[1] *Loc. cit.* p. 152.

bends back. In the Kangaroo and Wallaby it is directed backwards, and apparently also in the Koala.

The fissure which separates the anterior lobe of the cerebellum is directed forwards in the Thylacine [1], but is nearly vertical in the Kangaroo and Wallaby, though with a decidedly forward inclination. I do not feel able at present to identify any of the remaining fissures of the Thylacine's brain with those of the Kangaroo.

With regard to the other viscera, I have not much to add to Prof. Cunningham's [2] excellent account; I may remark, however, that one of the papillary muscles connected with the right auriculo-ventricular valve is attached to the free wall of the ventricle. I call attention to this point since Mr. Hatchett-Jackson [3] has particularly mentioned as a characteristic of the Marsupials that all these muscles arise from the septal part of the ventricular wall. I have preserved a record of the number and arrangement of the papillary muscles in order to compare them with those of other Marsupials. I do not, however, think that a description would serve much purpose until I am in the position to describe a large series of specimens; the variation in these muscles from individual to individual needs to be first discounted.

February 17, 1891.

Prof. Flower, C.B., LL.D., F.R.S., President, in the Chair.

Mr. Edward Gerrard, Jr., exhibited a very fine head of a Koodoo Antelope (*Strepsiceros kudu*). The specimen had been shot by Mr. F. C. Selous, near the River Macloutsie, Khama's Country, South Africa, on May 23rd, 1890. The length of the horns was 3 ft. 9½ in. on one side, and 3 ft. 9 in. on the other, measured in a straight line from the base to the extremity.

Mr. T. D. A. Cockerell exhibited some abnormal specimens of *Clausilia rugosa*, Drap. (*C. bidentata*, Ström), and made the following remarks:—

The specimens exhibited were all found in the same place, at the base of a wall, at Isleworth, Middlesex, on Feb. 15th. The specimen with the two apertures (figs. 1, 2, p. 146) shows a curious result of a fracture of part of the body-whorl behind the original mouth of the

[1] The importance of this furrow is shown by the fact that it is the most prominent one next to the rhinal fissure in the Opossum. See Appendix to Dr. Elliott Coues's paper "On the Osteology and Myology of *Didelphys virginiana*," Mem. Bost. Soc. Nat. Hist. 1872, by Dr. Wyman, where a figure will be found.

[2] In Zool. Chall. Exp. vol. v.

[3] Forms of Animal Life, 2nd ed. p. 369.

shell, which remains uninjured. Instead of merely repairing the wall of the shell, the animal has constructed a new aperture, which, although not so perfectly formed as the first one, still has the lamellæ and general structure of the normal mouth. A similar monstrosity is figured by Moquin-Tandon, Hist. Nat. Moll. France, pl. xxiv. fig. 19.

The other two specimens (fig. 3) are noticeable because, although from the same place, they differ so much in size, form of the aperture,

Fig. 1.

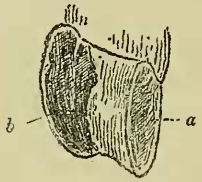


Fig. 2.

Fig. 3.

Specimens of *Clausilia rugosa* from Isleworth, Middlesex.

Figs. 1, 2. Specimen with two apertures, the new one having been formed after a fracture of part of the body-whorl.

Fig. 3. Specimens having different characters, A being fully developed, and B probably stunted by an algoid growth.—A. Nearly symmetrically pyriform aperture of clean specimen, 12 millim. long; B. Non-symmetrically pyriform aperture of specimen coated with alga, and 10 millim. long.

and general structure that they look almost like examples of different species. It will be noticed that the larger specimen, 12 millim. long, with the nearly symmetrically pyriform aperture, is clean; while the smaller one, 10 millim. long, with the asymmetrically pyriform aperture, is coated with an algoid growth, which was green and conspicuous when the shell was found. Possibly this affords us a clue to the reason of the differences between the shells. Messrs. Bornet and Flahault (Bull. Soc. Bot. France, 1890) have been investigating certain parasitic algæ which live in shells, and, penetrating under the epidermis, destroy the hard structures by degrees. This has been observed in marine and freshwater shells, and is very possibly one

cause of that very common condition among the latter known as decollation. Is it not therefore possible that something of the kind may occur in the case of those small examples of *Clausilia rugosa* one often finds coated with a green algoid growth? The destruction caused by the alga would seem in this case to be of a very gradual character, not preventing the growth of the shell, but tending to make it small and on the whole less well-formed.

If this explanation is correct, the peculiarities of these small forms are clearly somatogenic, and it would be a matter of interest to ascertain whether they are in any degree inherited.

The species here called *Clausilia rugosa* has been divided by some authors into two or more, and the characters given for the supposed distinct species are often such as we have just noted above. Moquin-Tandon (1855) described *C. perversa*, which somewhat resembles our small form, and *C. nigricans*, which in the form of the aperture is like our larger one. Westerlund (1884) gave *C. bidentata*, Ström, 10 millim. long, and *C. rugosa*, Drap., 12 millim. long; and these are just the respective dimensions of our two forms.

It thus appears that, although these specimens do not prove the specific identity of these and other segregates from *C. rugosa*, they show that some of the characters relied upon to distinguish them are probably of no specific importance.

Mr. Boulenger exhibited the renewed left pectoral limb of a *Protopterus annectens*, living in the Society's Gardens, and made the following remarks:—

A few days ago Miss Catherine Hopley kindly informed me that one of the *Protopteri* now living in the Society's Gardens, after having had its left pectoral limb nibbled off by one of its companions about three months ago (as she had been informed by the keeper of the Reptile-house), had reproduced the said limb in a trifid condition. Fearing that so interesting an object might be lost by being again bitten off, I removed the reproduced trifid portion of the limb, which I now exhibit.

The limb was bitten off about two-thirds of an inch from its base, and on being regenerated presented, in addition to the prolongation of the longitudinal axis with its series of mesomeres, two preaxial or dorsal branches, similar to, but shorter and more slender than, the axial; these additional branches are, like the axial, divided into cartilaginous segments, comparable to the parameres of the *Ceratodus*-limb. My friend Prof. Howes, who has kindly made a preparation of the specimen, has ascertained that the supplementary rays are fused together at the base by their proximal segments.

A few years ago Albrecht[1] described and figured a *Protopterus* with a bifid right fore limb, remarking that its condition might be regarded as giving support to Goette's and Wiedersheim's theory of the evolution of the pentadactyle limb. The specimen now noticed

[1] Sitzungsb. Ak. Berl. 1886, p. 545, pl. vi.

is therefore interesting as invalidating such an interpretation, as well as the morphological significance attached by Albrecht to his specimen, the bifid limb of which, I have no doubt, was likewise produced by regeneration. Whether the case now noticed is one of reversion, as I have noticed in the scaling of the reproduced tails of Lizards, or merely comparable to the bifid or trifid tails of the same Reptiles, is a point on which I will refrain from expressing an opinion.

Mr. Boulenger also exhibited young specimens and eggs of a South-African Siluroid fish, *Galeichthys feliceps*, which had been sent to him by Mr. J. M. Leslie, of Port Elizabeth, with the information that the ova had been obtained from the mouth of the adult fish. The fact that in the genera *Arius* and *Osteogeniosus* the male takes charge of the eggs in this manner was well known, but Mr. Leslie's observation was of importance as adding a third, though closely allied, genus to the list of the Siluroids which thus protect their offspring. According to Mr. Leslie, the number of eggs in one fish's mouth was about thirty, each of which measures about six lines in diameter.

The following papers were read :—

1. On the Probable Existence of a Jacobson's Organ among the Crocodilia; with Observations upon the Skeleton of that Organ in the Mammalia, and upon the Basi-Mandibular Elements in the Vertebrata. By G. B. Howes, F.Z.S., F.L.S., Assistant Professor of Zoology, Royal College of Science, London.

[Received February 17, 1891.]

(Plate XIV.)

I. The Black Caiman (*Caiman niger*), of Inter-Tropical America, is, with the exception of *Tomistoma*, the only Emydosaurian living in which the vomers are freely intercalated between the bones of the palato-maxillary series. In *Tomistoma* they are so disposed as to be visible from beneath over a short and constricted area between the posterior ends of the palatines, as was first shown by Müller and Schlegel [1]. In *Caiman niger* they are, unlike those of all other Crocodilia, prolonged forwards into the premaxillo-maxillary region, and their inflated free ends (*vo.'''*, Plate XIV. fig. 7) occupy a wide inter-

[1] *Cf.* Huxley, Journ. Linn. Soc. Lond., Zool. vol. iv. pp. 17, 19 (1860). For synonymy see Boulenger's Brit. Mus. Cat. of Chelonians, Rhynchocephalians, and Crocodiles, 1889, p. 276.